

# NASA TECH BRIEF

## Goddard Space Flight Center



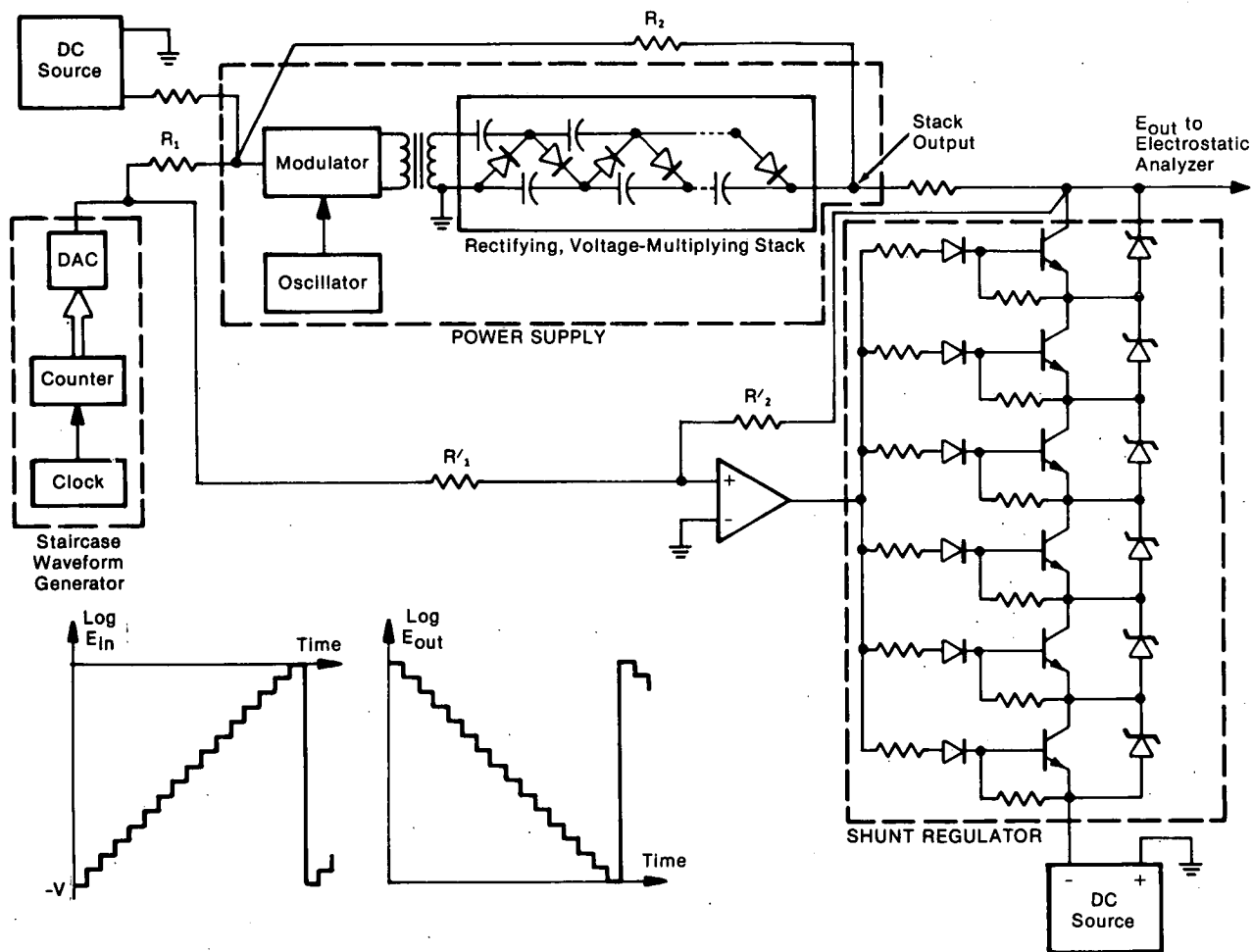
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### High-Voltage Stepping Supply With Fast Settling Time

A high-voltage dc stepping power supply (see figure) has been developed for driving an electrostatic analyzer. The supply has a relatively-fast settling time for the voltage steps. A waveform generator is used to derive a low-voltage staircase waveform that feeds a relatively-long response-time power supply. The

power supply has a high output voltage that is a predetermined multiple of the input voltage.

The inputs to the power supply are a constant dc bias and the signal from the staircase waveform generator. The clock frequency of the waveform generator is approximately 50 Hz to provide 20-ms



High-Voltage Stepping Supply

(continued overleaf)

spaced steps. In the power supply, these signals are modulated and pass through a step-up transformer and a rectifying, voltage-multiplying stack.

Without the bias from the dc source, the supply output would range from zero to 1,500 V. Biasing raises the stack output, an additional 100 V above ground for a range of 100 to 1,600 V. The stack output does not quite follow the staircase waveform, and a fast shunt regulator is resistor coupled to the output to achieve a more faithful high-voltage reproduction of the generator signal. The 100-V bias provides freedom for the shunt regulator to operate for positive and negative dc voltage variations.

The shunt regulator comprises a series string of six transistors, each having a collector-to-emitter breakdown voltage of 400 V. The transistors are shunted by 250-V to 300-V zener diodes to limit the maximum voltage across each transistor. A 5-V dc source at the emitter of the bottom transistor provides bias to compensate for the combined transistor-saturation voltages.

The descending-staircase final-output waveshape closely follows the input, with a settling time of 200  $\mu$ s between steps. The power supply charges rapidly and provides a rising flyback from zero to 1,500 V in about 2 ms.

**Note:**

Requests for further information may be directed to:

Technology Utilization Officer  
Goddard Space Flight Center  
Code 704.1  
Greenbelt, Maryland 20771  
Reference: TSP75-10191

**Patent status:**

This invention has been patented by NASA (U.S. Patent No. 3,869,659). Inquiries concerning non-exclusive or exclusive license for its commercial development should be addressed to:

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